Math 251/Buad427 **ACTIVITY 3:** Formulating Linear Programming Problems; Integer and Binary variables

Why

The solution process for linear programming problems is quite straightforward [though not necessarily easy], and can be programmed. What requires the intelligence of human beings is the formulation of problems and the interpretation of results. Certain types of restrictions (percentage limits, integer requirements) require special handling or specialized solution methods

LEARNING OBJECTIVES

1. Work as a team, using the team roles
2. Be able to determine the variables and objective, and write the constraints, for a problem that fits the linear programming model
3. Recognize integer and binary constraints and be able to represent them.
4. Recognize when a model requires auxiliary binary variables, and be able to write them.

CITERIA

1. Success in working as a team and in fulfilling the team roles.
2. Understanding of the material by all team members
3. Success in completing the exercises.

RESOURCES

1. Your text section 3.5 (Integer Linear Programming Models)
2. The notes "BinaryVars.doc" and spreadsheet "Binaryvars.xls" from class Wednesday (available in the "Linear Programming Models - Notes" folder on the Blackboard site)
3. Microsoft Excel, and the Solver, on the college network
4. 50 minutes

PLAN

1. Select roles, if you have not already done so, and decide how you will carry out steps 2 and 3
2. Work through the exercises given below you will submit one (team) copy of the work, with the usual reports [see the syllabus]
3. Assess the team's work and roles performances and prepare the Reflector's and Recorder's reports including team grade.
4. Be prepared to discuss your results

EXERCISES

1. Set up and solve exercise 32a on p.178 as an integer linear programming problem. That is
   (a) Define variables
   (b) Write (algebraically) the objective and constraints (you will need a variable for each of the 6 vehicle models)
   (c) Set up and solve an Excel spreadsheet model corresponding to this model. and give an answer (requires words) — how many vehicles of each type, what is the total passenger capacity?
2. Set up and solve Exercise 34 on p. 179 (including the conditions in part b) as a binary linear programming problem [The usual three parts — as listed in #1]
   You will need a binary variable (1 for yes, 0 for no) for *each project*
   To say "at most one of X_i, X_j is 1" you can use $X_i + X_j \leq 1$
   "$X_i$andX_j are both 0 or both 1" is represented by $X_i - X_j = 0$
   "At least 1 of X_i, X_j is 1" is represented by $X_i + X_j \geq 1$
   "X_i is 1 *only if* X_j is 1" is represented by $X_i - X_j \leq 0$ (or by $X_j - X_i \geq 0$)

READING ASSIGNMENT (in preparation for next class meeting)

Read The notes on Distribution Models handed out today (also on Blackboard - Notes area, Distribution Models folder). We will be working with an alternative approach to the material in 4.2 and 4.4 of the text.

SKILL EXERCISES:(hand in - individually - at next class meeting)

Text p. 168: #33, 39